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NASA TECH BRIEF



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ABTRAJ-On-Site Tracking Prediction Program

The problem:

To give the Deep Space Network tracking stations the ability to generate spacecraft predictions with local, on-site computers such that recourse to the central JPL computing facility would not be necessary.

The solution:

The ABTRAJ program is designed to provide tracking stations with the capability of generating spacecraft predictions with on-site computers.

How it's done:

The program is comprised of two major sections: the main prediction portion of the program and a trajectory subroutine. The trajectory subroutine is designed to produce a spacecraft ephemeris during planetary cruise phases (when spacecraft is near no major planetary bodies). It uses a third-order Runge-Kutta numerical integration scheme coupled with a spacecraft/sun/earth/moon trajectory model.

The main program first calls the trajectory subroutine, which spans the desired predict interval with spacecraft ephemeris data written on magnetic tape. The main program then requests spacecraft frequency information and station location information. Finally, the main program enters the central loop in which spacecraft ephemeris data is read off magnetic tape, various coordinate transformations are performed, and the appropriate prediction parameters are computed and printed. This process is repeated until the predict set is complete.

When initialized, ABTRAJ calls the AVOID subroutine, which requests certain information at the typewriter and then computes and writes on magnetic tape spacecraft ephemeris data and also transfers back to

the main program certain trajectory information. Control is now transferred back to the main program, which requests at the typewriter the spacecraft transmitter frequency, the spacecraft transponder frequency, and the station number.

A table lookup routine is used to produce the appropriate station and location parameters, which are transformed to geocentric cartesian coordinates. A track synthesizer frequency is chosen, if necessary, and the Greenwich hour angle of the predict start time is computed. The appropriate hour angle constraint is chosen as a function of the station number and, at this point, the program is ready to enter the central loop.

Spacecraft ephemeris data are read from magnetic tape and updated, the Greenwich hour angle is updated by the ephemeris time interval, round trip light time is computed, and the spacecraft position is calculated for the current prediction time minus one-way light time by use of a three-point quadratic interpolation function. The spacecraft position is successfully transformed to a topocentric cartesian coordinate system and the elevation angle is computed.

Next, the Greenwich hour angle of the current prediction time minus round-trip light time is computed, the downlink range rate is calculated, and the earth is rotated to the new Greenwich hour angle. At this point, the uplink range rate is computed, the spacecraft coordinates are calculated for current prediction time plus one-way light time, the Greenwich hour angle is rotated back to the current prediction time, the new spacecraft coordinates are transformed to a topocentric framework and the range rate is computed.

The need for a new track synthesizer frequency is investigated, the doppler quantities are computed, and the prediction parameters are printed. Finally,

(continued overleaf)

new spacecraft ephemeris data are read, a determination of whether the ephemeris data are exhausted is conducted, and, if not, the process is repeated until the ephemeris data are exhausted.

Notes:

1. This program is written in the FORTRAN II language for use on the SDS-920/930 computer system.
2. Inquiries concerning this program may be directed to:

COSMIC
Computer Center
University of Georgia
Athens, Georgia 30601
Reference: B69-10103

Patent status:

No patent action is contemplated by NASA.

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